

MODELING PERFORMANCE IN C4ISR SUSTAINED OPERATIONS: A MULTI- LEVEL APPROACH



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Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE JUN 2003		2. REPORT TYPE		3. DATES COVERED 00-00-2003 to 00-00-2003	
4. TITLE AND SUBTITLE Modeling Performance in C4ISR Sustained Operations: A Multi-Level Approach (Briefing Charts)				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory,Biodynamics & Protection Division,Brooks AFB,TX,78235				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 18	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Credits



- **Dr. James C. Miller: Air Force Research Laboratory Warfighter Fatigue Countermeasures R&D Program**
- **Dr. Linda Elliott: Veridian Engineering**
- **Dr. Michael Coover: University of South Florida**
- **21ST Century Systems, Inc., providing the Agent Enabled Decision Group Environment (AEDGE) software**



Issues



- **Modeling**
 - **Agent-based Software Architecture**
- **Assessment**
 - **Scenario Design**
 - **Construct Validity / Measures**
 - **Multi-level Modeling of Interrelationships**
- **Application**
 - **Criterion Performance (Training)**
 - **Fatigue Models**



Software Architecture



- **AEDGE- Agent-Enabled Decision Group Environment**
 - **Federation of IA agents**
 - **Heterogenous / Distributed / Autonomous / Concurrent**
 - **Component-based Architecture**
 - **Hierarchical Collective Agents Network (HCAN)**
 - **4 Modules**

* Data Management	* Control and Adaptation
* Reasoning	* User Interface/Visualization



Data Fusion and Decision Support

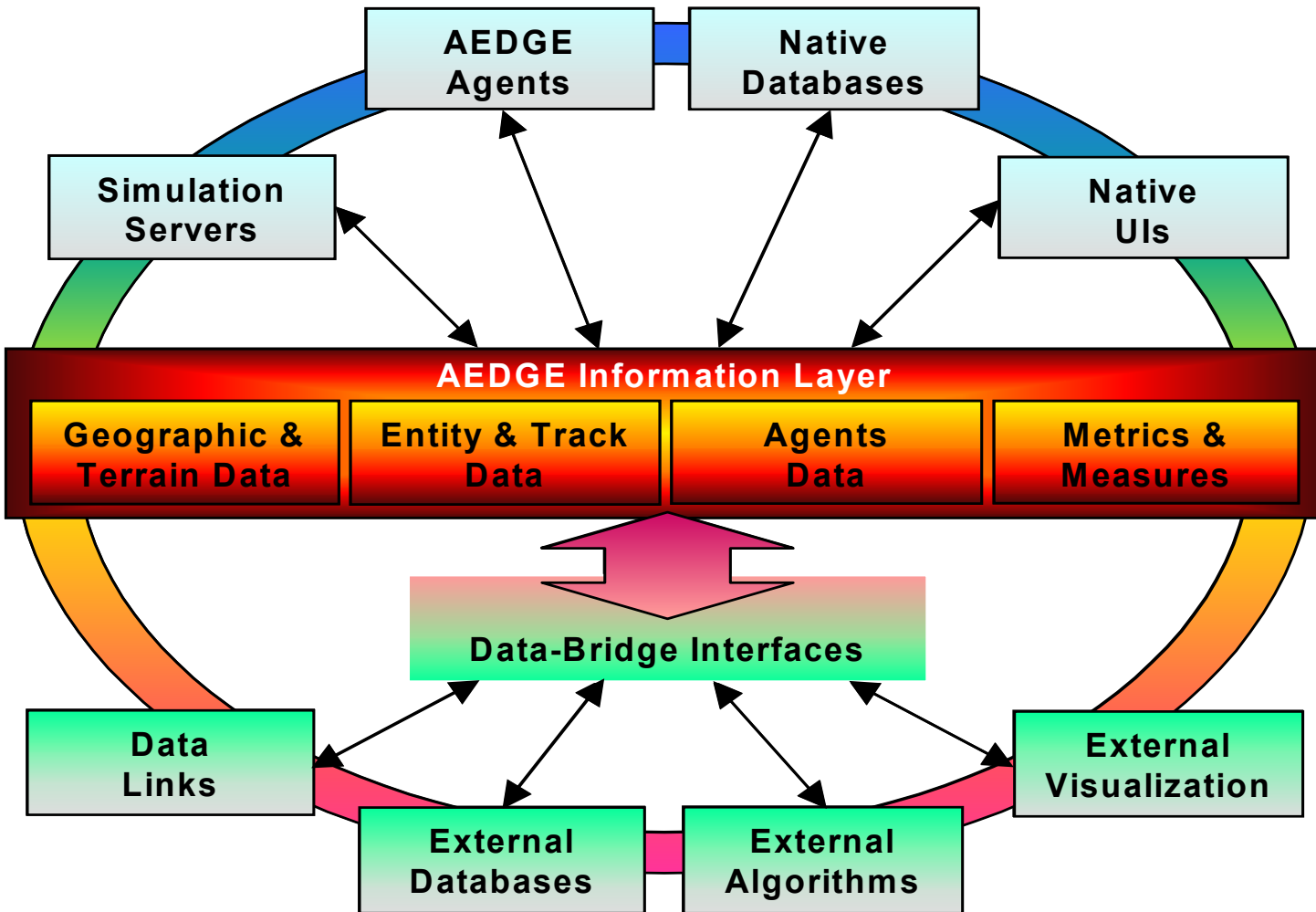
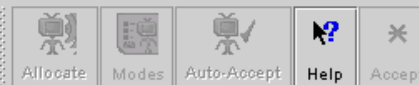
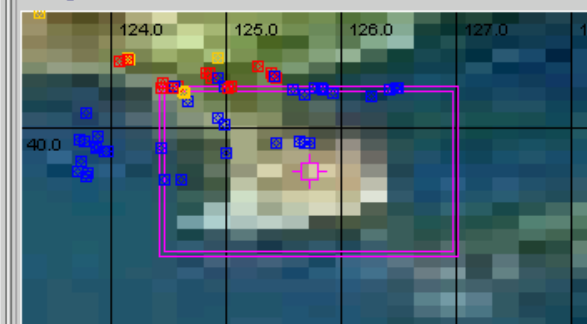


Figure 1. 21CSI's AEDGE™ Product



Comm Nav Scores Orders

Navigation



Z

C

F

Coordinates

Center

Extent

Curr.Lat

36.435763888888886

5.614583333333336

Curr.Lon

128.2079443247495

4.994152046783611

New Lat

36.435763888888886

5.614583333333336

New Lon

128.2079443247495

4.994152046783611

☒ Aspect Lock

Apply

Previous

Home

Next

Global View



Lat/Lon= 37° 25' 55" N / 130° 04' 47" E 0.0 ft



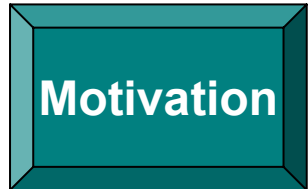
Scenario Design



- **Operational Relevance**
 - **C4ISR assets / roles**
- **Construct Validity:**
 - Need to ELICIT**
 - **Individual Decision-making**
 - **Type / Timing of Decision Errors**
 - **Team Planning**
 - **Team Communication**
 - **Team Coordination**
 - **Team Adaptive Decision-making**



Current Research Goal Modeling of:



MOTIVATION

Measured by:

Team Efficacy survey

Communication data

**-Encouragements to
each other**

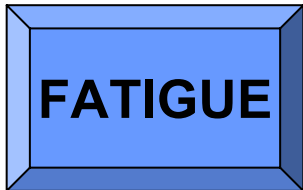
**-Conscientiousness
(Neo PI)**



Current Research Goal Modeling of:



FATIGUE



Measured by:

Stanford Sleepiness Scale

Profile of Mood States

Time



Current Research Goal Modeling of:



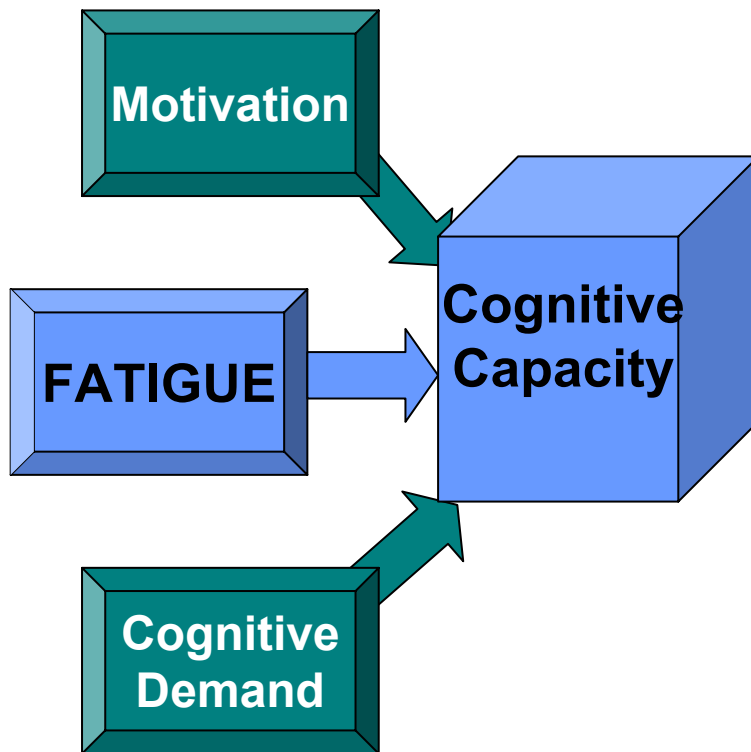
COGNITIVE DEMAND

Determined by complexity
of scenario





Current Research Goal Modeling of:



COGNITIVE CAPACITY

In part measured by
experience:

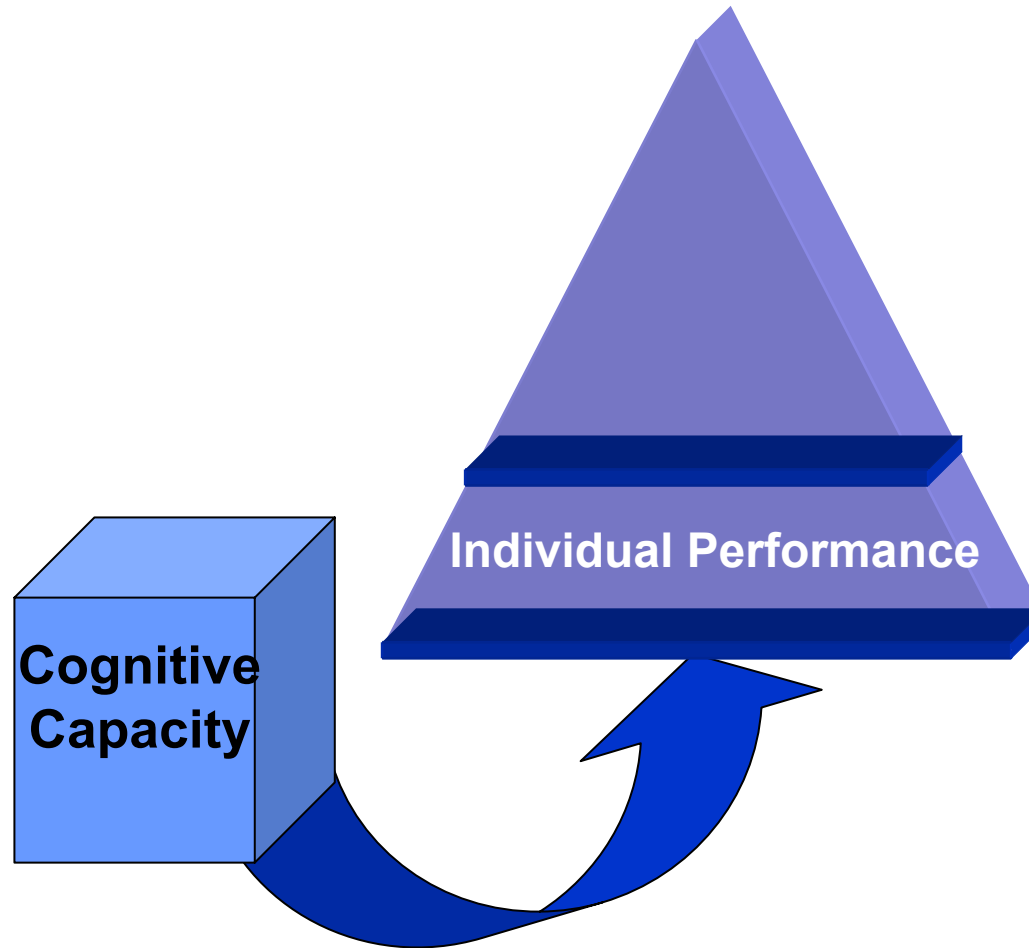
ABC Course

1 week AEDGE training

Biographical data



Current Research Goal Modeling of:





Current Research Goal Modeling of:



Individual Performance and Decision-Making

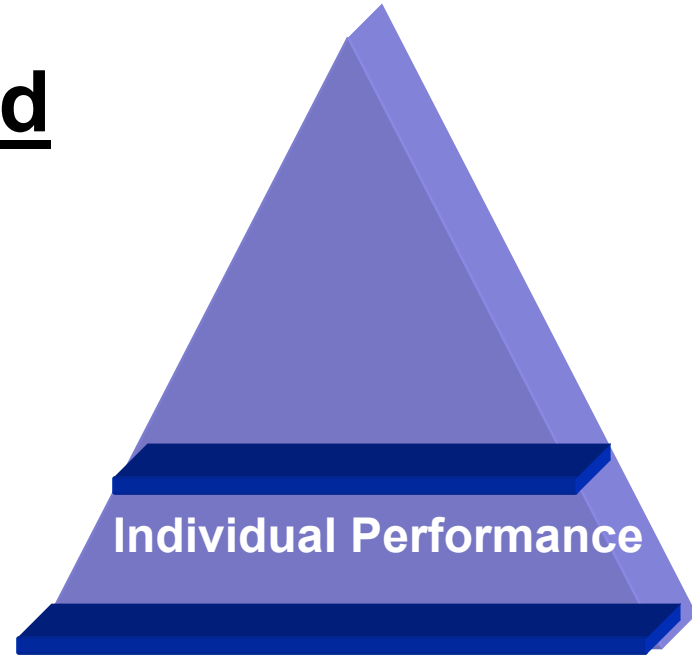
Measured by:

Fuel management

Asset ownership

Latency

ANAM battery: reaction time,
short term memory, multitasking





Current Research Goal Modeling of:



Team

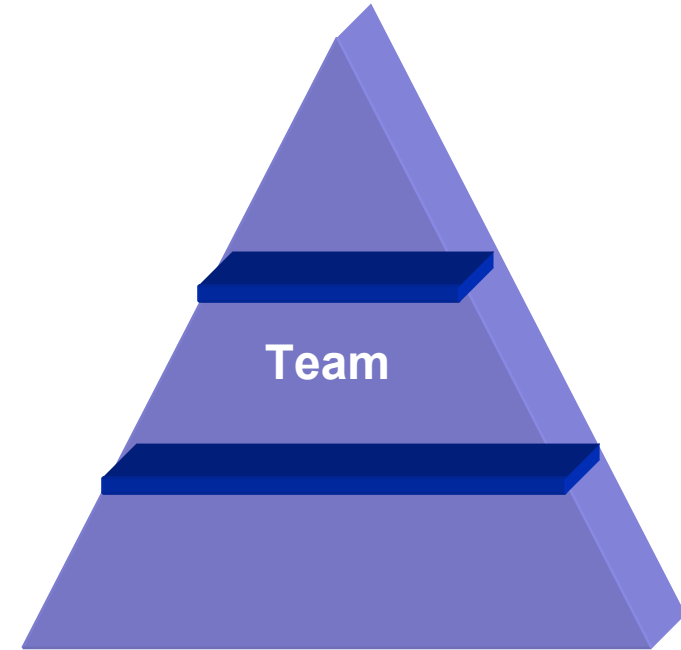
Measured by:

Communications

-Strategy

-Sequencing of assets and
targets

Handovers





Current Research Goal Modeling of:



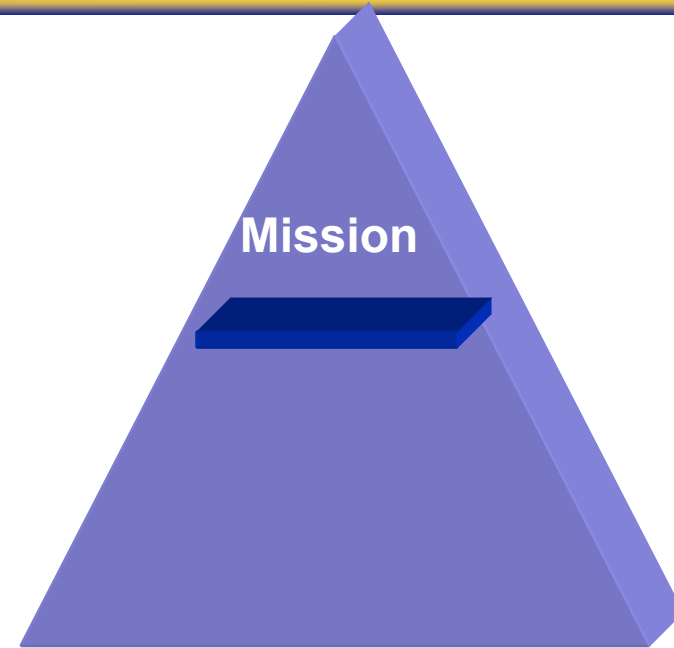
Mission

Measured by outcomes:

Assets lost

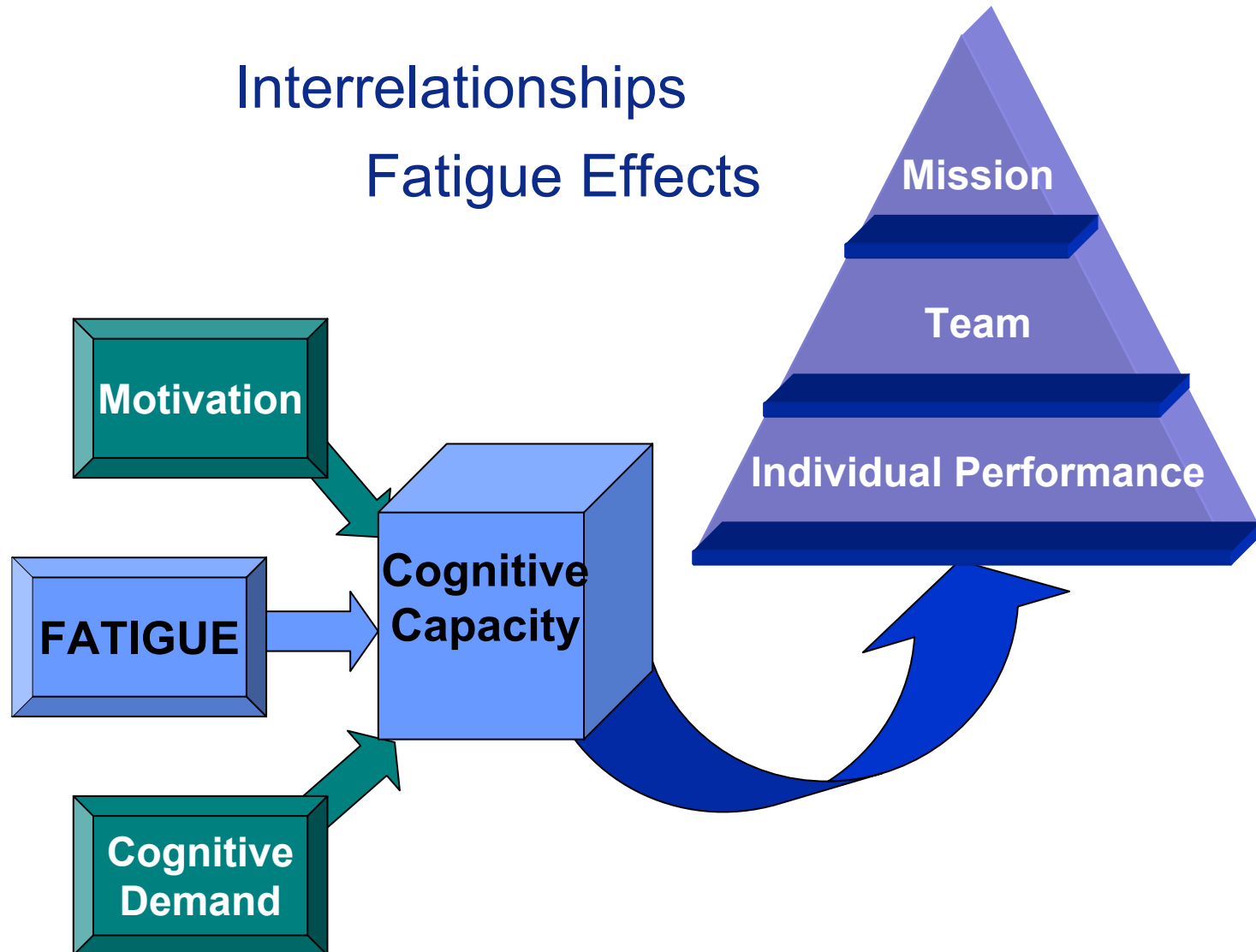
Enemies destroyed

Objectives fulfilled





Current Research Goal Modeling of:





Multi-Level Modeling of Data



- **Multiple Measures at different levels & across time**
 - Individual Differences
 - Individual performance
 - Team performance
 - Team Outcomes
- **MLWin**
 - <http://multilevel.ioe.ac.uk/features/index.html>
 - **The Third Edition of Multilevel Statistical Models is to be published early in 2003. For details and a preview visit http://www.ioe.ac.uk/hgpersonal/multmodels-edition3/multilevel_statistical_models-third_edition.htm**
- **Consultant: Michael Coover, USF**



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